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Experimental determination of phase equilibria of a basalt from Piton de la Fournaise (La Réunion island): 1 atm data and high pressure results in presence of volatiles.

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To understand the petrogenetic relations between the 4 groups of lavas erupted at Piton de la Fournaise (PdF), constrain the structure of the feeding system and the magma storage conditions, experimental phase equilibria have been determined, both at 1 atm and high pressures (HP), on a lava representative of Steady State Basalts (SSB). The lava ($\text{SiO}_2=49.2$ wt%, $\text{MgO}=7.8$ wt%, $\text{CaO}/\text{Al}_2\text{O}_3=0.81$) was fused at 1400°C , 1 atm in air. The resulting glass was crushed and the powder directly used as starting material.

The 1atm experiments were performed with the wire-loop method in a vertical CO-CO_2 gas mixing furnace. To minimize Fe-loss from the charge, experiments were repeated under constant T- $f\text{O}_2$ conditions to progressively saturate the suspension wire with Fe. Intermediate charges were dissolved in HF and the charge from the last cycle retained for detailed study. Analyses of experimental products are in progress.

The HP experiments were carried out in an internally heated pressure vessel, at 50MPa and 400MPa, between $1100\text{-}1200^\circ\text{C}$ and under fluid-present conditions. Glass (30-50 mg) plus 10% in mass of volatiles (H_2O or $\text{H}_2\text{O}+\text{CO}_2$) were loaded in Au80Pd20 capsules. Distilled water and $\text{Ag}_2\text{C}_2\text{O}_4$ (CO_2 source) were weighted to give charges with $x\text{H}_2\text{O}$ initial (molar $\text{H}_2\text{O} / (\text{H}_2\text{O}+\text{CO}_2)$) ranging from 1 to 0. Run durations lasted for 2-14h. Redox conditions were controlled by loading a given proportion of H_2 gas in the vessel (3 bar H_2 for 50MPa, 5 bar H_2 for 400MPa). Experimental $f\text{H}_2$ were determined by solid Pd-Co sensors, leading to $f\text{O}_2$ conditions approaching NNO-1. All experiments were rapidly drop quenched and products analyzed by SEM, EMPA and $\mu\text{-FTIR}$ Spectroscopy. To overcome Fe-loss, both capsule Fe pre-saturation and charge Fe pre-enrichment were tested. The first method was shown to be time-consuming and fraught with difficulties while the second is still being developed. Consequently, the experimental data presented here were obtained with no attempt to circumvent Fe loss, resulting in losses around 10-25%.

Results at 50 MPa lead to a crystallization sequence in the order olivine (ol, + spinel), clinopyroxene (cpx), plagioclase (plag) in marked contrast with previous experimental results under volatile-free conditions. Volatile concentrations in experimental glasses (0.5-1 wt% H_2O , 30-180 ppm CO_2) are within the range of natural glass inclusions. Fo contents, cpx Mg# and plag An contents match compositions of natural phenocrysts. Preliminary experiments at 400 MPa indicate a change in the crystallization sequence, olivine being replaced by cpx as the liquidus phase. Our data illustrate the importance of volatiles in controlling the order of crystallization even at low concentrations.